Before the
Federal Communications Commission
Washington, D.C. 20554

In the matter of	)	
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Interference Immunity Performance Specifications for Radio Receivers	)	ET Docket No. 03-65
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	)	
Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television	)	MM Docket No. 00-39
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COMMENTS OF NOKIA INC.

Nokia Inc. ("Nokia") submits these comments in response to the *Notice of Inquiry*[1] in the above-captioned proceeding. Nokia applauds the Commission for moving forward with the work initiated by the Spectrum Policy Task Force to review and update spectrum policy, in particular attempting to tackle the difficult issues of interference management and access to spectrum. The goal of promoting more efficient utilization of spectrum is a laudable one. Nokia welcomes the opportunity to discuss the issues surrounding interference immunity performance specifications for radio receivers, particularly as they relate to mobile services.

Nokia is the world leader in mobile communications. The company is the leading supplier of mobile phones and a leading supplier of mobile, fixed broadband and IP networks. Nokia is a broadly held company with listings on six stock exchanges.

Receiver Performance Parameters

As noted by the Commission in this Notice of Inquiry, "improvements in receiver performance almost always increase production costs, and so there are trade-offs in costs and performance that must be balanced."[2] In the near to medium-term, there are no new or emerging technologies that alter this picture in any fundamental way. Any improvements in receiver performance continue to be subject to a variety of parameters such as selectivity, sensitivity, dynamic range, automatic RF gain control shielding, modulation method and signal processing.

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[1] *Interference Immunity Performance Specifications for Radio Receivers*, Notice of Inquiry, *ET Docket No. 03-65*, (rel. March 23, 2003) (NOI),
[2] *Id*, ¶10.

However, it is difficult to rank the relative importance of these parameters and the impact each one will have on performance and cost. The relative importance of each parameter is largely a function of the specific service, system and band where the receivers operate.

In the case of Commercial Mobile Radio Services ("CMRS"), for example, industry voluntarily develops mobile receiver and transmitter requirements, through the 3G Partnership Projects, 3GPP[3] and 3GPP2[4], including but not limited to: reference selectivity under a multitude of channel conditions and for a variety of channels, dynamic range, maximum input levels, adjacent channel selectivity ("ACS") blocking, intermodulation and spurious emissions. These requirements are developed to ensure co-existence with minimal performance degradation among interfering systems in all applicable cases. In developing these requirements, 3GPP and 3GPP2 take into account the trade-offs of cost and performance through extensive simulations modelled on deployment scenarios in all relevant operating bands. The scenarios are complex and consider a variety of factors specific to CMRS services operating in these bands, such as co-existence between different cellular technologies. Implementation constraints, such as size, energy consumption, cost, performance and other factors, are also taken into account in these analyses.

In the 3G Partnership Projects, receiver standards are not developed as stand-alone requirements. Rather, receiver standards are considered in conjunction with transmission standards, for example, setting selectivity requirements for receivers in accordance with the spurious levels of the interfering transmitters to minimize the costs of tighter blocking requirements. It is important that any receiver and transmitter standards be developed in tandem if they are to be useful.

The experience of the 3G Partnership Projects demonstrates the difficulty of attempting to understand and rank these receiver performance parameters in a generic way. Even within the same band and allocation category, the trade-offs with cost and performance are system-dependent and require analysis of individual systems and the bands in which they operate. For example, a WCDMA base station has very different dynamic range requirements from a GSM base station and different selectivity is required for a wideband system as opposed to a narrowband system. To generalize these parameters across a variety of services would result in receiver standards that fail to

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[3] 3GPP or the Third Generation Partnership Project is a collaboration agreement bringing together a number of telecommunications standards bodies (such as T1) to produce, maintain and update globally applicable Technical Specifications and Technical Reports for a 3rd Generation Mobile System based on GSM core networks and the radio access technologies that they support such as UTRA, GPRS and EDGE. See http://www.3gpp.org

[4] 3GPP2 is a collaborative third generation (3G) telecommunications specifications-setting project, like its sister project 3GPP, that develops global specifications for ANSI/TIA/EIA-41 Cellular Radiotelecommunication

maximize performance, cost effectiveness and efficient use of the spectrum. Likewise, different bands have different interference environments, with different players, system constraints and even variations on a time or geography basis within a particular band. The impact on adjacent bands and their users is also an important consideration. To treat these environments generically, rather than understanding each one would lead to excessive costs and performance impact with minimal benefits.

However, developing useful receiver requirements specific to each operating environment requires significant resources and time by industry and government. The costs of doing this should be carefully weighed against the benefits. The experiences of industry-led standards development groups like 3GPP or 3GPP2 show that industry is in the best position to provide the most up-to-date data on technologies, systems and operating environments and provide the resources necessary to develop appropriate standards that best balance the benefits and costs.

The extreme difficulty of developing an adequate understanding of a variety of individual and dynamic interference environments highlights the challenges of trying to implement interference temperature, one concept proposed in the Spectrum Policy Task Force[5]. The concept of interference temperature is a problematic one at best. By setting maximum permissible levels of interference with the intent of increasing capacity and allowing more users to exploit the spectrum, the noise floor will rise with each new user. Any increase in the noise floor will reduce the overall capacity of the spectrum, according to Shannon's Law, even reducing the capacity of the newly introduced device or system that is causing the rise in noise. It is not clear how the interference temperature metric will accommodate changes in the environment, such as a rise in the noise floor as the result of new services operating in the band.

The principle of interference temperature is assumed to be that receivers should be able to operate in the worst case, of "likely" co-channel interference. To limit performance expectations to that achieved in the presence of the worst "likely" interference would reduce the consumer benefits substantially. Noise is typically present for a short duration in time or over a narrow band of spectrum. An efficient radio will maximize the useful capacity that is available most of the time and where noise arises, will reduce performance for a short period of time or change to an interference-free channel. We see little value in restricting the performance of the radio at all times to address

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Intersystem Operations network evolution to 3G and global specification for radio transmission technologies supported by ANSI/TIA/EIA-41. See http://www.3gpp2.org .

[5] See *NOI,* ¶ 9, nn. 11-12.

periodic and infrequent interference spikes. For this reason, any survey of interference environment should include a measurement of the probability distribution function.

Incorporation of Receiver Immunity Performance Guidelines and Standards Into Spectrum Policy

The Commission seeks comment on the three principle approaches for implementing measures for improving receiver performance: voluntary industry standards; guidelines promulgated by the Commission, either in technical publications or advisories in the rules; and mandatory standards adopted in the rules. The Commission noted that it "would prefer to rely primarily on voluntary programs that are supported and managed by industry, in conjunction with user groups as appropriate, to establish and maintain guidelines and standards for receiver immunity performance, rather than formally incorporate them into [the] regulatory rules."[6] Nokia agrees with the Commission that this should be the preferred method for adopting measures that facilitate improved receiver performance, particularly for services subject to market forces.

As the Commission states, this approach provides the "greatest flexibility…to modify and update technical guidelines and standards in response to changes in technology, consumer desires, and economic conditions" and "spectrum users have an incentive to reach voluntary agreements that provide for additional spectrum use."[7] This is particularly true for bands where market forces provide an economic incentive for operators to use their spectrum as efficiently as possible. This approach also permits the greatest level of freedom for manufacturers to develop innovative technologies.

Nokia cautions the Commission against moving towards greater regulation through mandatory standards or further government regulation for mobile services. The Commission has moved towards a more market-based approach to regulation in recent years. The Spectrum Policy Task Force Report states that the Task Force's mission is to move the Commission's spectrum policy "towards a more integrated, market-oriented approach that provides greater regulatory certainty, while minimizing regulatory intervention."[8] The mobile industry's current regime of voluntary industry-led standards has shown that this is indeed an effective model. The CMRS operators now serve more than 147 million subscribers nationwide[9] in a limited amount of spectrum where subscriber growth far

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[6] See *Notice of Inquiry on Interference Immunity Performance Specifications for Radio Receivers (ET Docket No. 03-65)*, Paragraph 18.
[7] *Id*, ¶18.
[8] *Spectrum Policy Task Force Report,* ET Docket No. 02-135*,* November 2002, p.1.
[9] Cellular Telecommunications and Internet Association (CTIA), *http://www.wow-com.com*

outpaces the licensing of additional spectrum. The Commission itself has noted that this industry is competitive and using more efficient technologies, increasing its deployment of digital technology to 88 percent of all wireless subscribers.[10] It is difficult to understand how further regulation of this competitive and efficient industry segment would accomplish the goals of greater spectrum efficiency and market competitiveness. Likewise, a move towards greater regulation would be inconsistent with the Commission's stated preference for market-oriented spectrum policy.

An additional consideration in the relationship between improved receiver performance and spectrum policy is the distribution of these benefits. With improved receiver performance comes greater capacity. Given that the incumbents shoulder the burden of improved receiver performance, in terms of cost and impact on system performance, any benefits of increased capacity should accrue to existing spectrum users who have made this additional capacity possible through their investments. In the case of licensed spectrum, the Commission should not allow new systems to take advantage of the additional capacity, particularly any introduced through an "underlay" or easement on the licensees' rights. Allowing more underlay users, and therefore reduced capacity for the licensee in its own band, amounts to a market distortion whereby the government creates economic disincentives for existing users to maximize spectrum efficiency

Incorporation of Receiver Immunity Performance Guidelines and Standards in Specific Radio Services

As mobile services are the area where Nokia has the greatest expertise and experience, we will limit our comments on specific radio services to mobile services. The current experience of commercial mobile services should serve as a model for the effective development of standards. Voluntary industry-developed standards have allowed operators of both licensed and unlicensed mobile services to maximize their use of the spectrum and minimize interference. For commercial mobile services, pressure from the markets provides a financial incentive for these spectrum users to utilize their spectrum as efficiently as possible.

As noted above, the CMRS industry collaboratively develops receiver and transmitter standards through the 3G Partnership Projects. The receiver standards developed in these bodies are quite stringent. Though voluntary, these standards are implemented by all CMRS operators in their bands to ensure the most efficient operation. This approach has worked well to mitigate interference concerns in those bands and has allowed the operators to exploit

[10] *Eighth Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Radio*

their spectrum to the greatest extent possible. Deployment of these standards has allowed the operators to handle exponential subscriber growth while minimizing interference.

Likewise, the wireless industry has cooperatively developed voluntary sharing etiquettes for unlicensed technologies such as Bluetooth and WiFi (802.11) through industry standards groups. While development of these sharing etiquettes often takes considerable time and resources by multiple players, as was the case with dynamic sharing frequency ("DFS") for WiFi, these voluntary sharing regimes have been effective in addressing interference concerns.

These voluntary standards were developed through thorough and complex processes that balance spectrum efficiency against consumer demand for small, lightweight and inexpensive devices with sufficient power and reliable service. These standards maximize efficient use of the spectrum while ensuring that the standards do not render the equipment unusable for or undesirable to consumers.

Summary

In conclusion, Nokia agrees with the Commission that improved receiver performance can help to improve spectrum efficiency, thus ensuring greater access to spectrum for all users. We also agree with the Commission's stated preference for relying on voluntary programs supported and managed by industry as the best method for ensuring improved receiver performance, particularly where market forces drive the need to use spectrum efficiently. This is the method most consistent with the Commission's general trend towards market-oriented spectrum policies that minimize government regulation. The experience of the mobile industry has shown this to be an effective mechanism for ensuring improved receiver performance while carefully balancing the trade-offs that result from such improvements.

Any standards for receiver performance that are developed, preferably by industry and on a voluntary basis, should be based on the individual operating environment. Generic standards would result in excessive costs with minimal benefits. They should be developed as part of overall efforts to address interference, for example developing receiver standards in conjunction with transmitter standards. Any receiver standards should also be sufficiently flexible to allow manufacturers the ability to develop innovative technologies and products.

Services, WT Docket No. 02-379, ¶34.

In developing and implementing standards to improve receiver performance, Nokia urges the Commission to consider carefully how the benefits from such improvements are distributed. The benefits of improved capacity as a result of improved receiver performance should accrue to the existing users who have invested to improve their receivers. To do otherwise, creates a disincentive for existing users to maximize spectrum efficiency in their band.